

VIA EFS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Patent Application of:		:	
Pierattilio Di GREGORIO		:	
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Conf. No.:	2819	:	Group Art Unit: 1732
		:	
Appln. No.:	10/811,604	:	Examiner: Patrick Butler
		:	
Filing Date:	March 29, 2004	:	Attorney Docket No.: 6023-175US(BX2592M)
		:	
Title:	METHOD FOR PRODUCING THERMO-INSULATING CYLINDRICAL VACUUM PANELS AND PANELS THEREBY OBTAINED		

DECLARATION OF PAOLO MANINI UNDER 37 C.F.R. § 1.132

I, Paolo Manini, declare and state as follows:

1. I am presently employed by SAES Getters S.p.A. ("SAES"), the assignee of the above-identified patent application, as Manager of the Vacuum Systems Business Area. In the period 1998-2003 I was the manager of the Vacuum Thermal Insulation Business Area which includes research and development in the field of the invention described and claimed in the above-identified patent application. I am making this Declaration in place of the inventor, Pierattilio Di Gregorio, who quit the company and is unavailable to make the Declaration.

2. My educational background and training are as follows. I graduated cum laude in Physics from Milan University in 1984 with a thesis in solid state physics. As a university student my studies included vacuum technology (included in the more general course on electromagnetic waves and plasma physics) and laboratory sessions (Plasma Physics and Solid State Physics) where vacuum equipment and apparatuses were routinely used. My post-graduation studies included short courses on “surface science” and “thin film deposition technologies,” organized by AIV (Italian Vacuum Association) and AVS (American Vacuum Association).

3. My work history and experience are as follows. After graduation, I joined Honeywell Information Systems Italia in 1985 as a researcher in charge of technological and failure analysis on silicon integrated circuits. In 1986 I joined the SAES corporate R&D laboratories as a researcher. During the following years I was in charge of studying and characterizing getter alloys and materials for several vacuum applications. As the head of the SAES Gas-Surface laboratory, I managed the activities of a team of 12 people in charge of investigating getter properties and developing novel getter solutions for industrial applications (lamps, vacuum thermal insulation, displays, etc.). From 1992-1998, I was responsible for the development of a specific getter solution (Combogetter[®]) for Vacuum Insulation Panels (VIPs). This work required extensive investigation and understanding of the properties of fillers, barriers, getters, and panel manufacturing processes. In late 1998 I moved to the Commercial Division of SAES as Manager of the Vacuum Thermal Insulation Business Area to follow this growing business. In this function, I was the organizer of the European Workshop “Vacuum Panel Technology for superinsulators in domestic appliances and industrial applications” held in Milan, November 1998, which sparked high interest in VIPs and led to the creation of the first Vacuum Insulation Association (VIA), based in the US and having SAES as one of the founding companies. I took part, as a member of the technical team, in the preparation of the ASTM C1484-01 standard on vacuum insulation panels, which was issued in 2001. I am an affiliate of the AIV (Italian Vacuum Association), sitting on the steering committee of the Association since 1989 and being currently Vice-President. Following an internal re-organization in business units of SAES, I moved recently to a new position as Manager of the Vacuum Systems Business Area, which deals with getter products for high and ultra high vacuum applications. I am author of more than 30 scientific publications related to vacuum, getter technology, material science, and vacuum insulation panels, as well as an inventor or co-inventor in several patents in the same fields.

4. Based upon my educational background, training, work experience, and the many years I have worked in this art, I believe that I am considered an expert in the field of thermo-insulating vacuum panels and the production thereof.

5. I am familiar with the prosecution history of the above application, and in particular, the final Office Action dated December 19, 2005. I am also quite familiar with the prior art relied upon by the Examiner, particularly U.S. Patents 5,792,539 of Hunter, 5,107,649 of Benson et al. and 6,336,693 of Nishimoto. I have also read and studied U.S. Patents 6,189,354 of Späth and 4,011,357 of Haase, both of which are totally unrelated to the presently claimed invention.

6. I am submitting this Declaration in order to correct the erroneous assumptions, misunderstandings and faulty reasoning of the Examiner in making the obviousness rejections in the final Office Action, and to demonstrate the non-obviousness of the presently claimed invention over the prior art relied upon by the Examiner.

Benson's Approach to Reducing Thermal Conductivity

7. At column 2, Benson poses the problem that ultra-thin, highly effective and long-lasting insulation panels are not easy to make (col. 2, lines 20-22), and goes on to discuss various attempts to improve insulation effectiveness with vacuum panels. However, while conceding that these prior art vacuum panels are more effective than conventional foam and fiberglass insulation panels, Benson concludes that truly effective and long-lasting insulation panels are not achieved by these prior art structures to the extent necessary (col. 2, lines 54-59).

8. Among the problems of such prior art panels is that plastic edge seals cannot maintain a vacuum over an extended period of time due to degradation and out gassing of plastic materials. Further, metal envelopes with welded seams will hold the required vacuum, but have the drawback that leak-free welds cannot be achieved in practice when the filler material includes "billions of microscopically fine glass fibers and perlite particles" as used in prior art panels, because a single particle or fiber intruding into the weld could create a microscopic leak (col. 2, line 62 – col. 3, line 6).

9. Benson's solution to these problems is to use envelopes obtained by welding two adjacent metal sheets spaced closely together with a plurality of spherical or glass or ceramic beads or other discrete shapes, which provide mechanical support and space while "minimizing

thermal conductance” (col. 4, lines 8-17). Such glass or ceramic beads minimize solid-phase conduction by having low thermal conductivity and nearly “point” contact with the metal sheets (col. 11, lines 61-65).

The Examiner’s Proposed Combination of Benson with Hunter

10. In the first full paragraph of page 3 of the Office Action, the Examiner concedes that Benson does not disclose the use of inorganic powders and porous organic foams inside the vacuum envelope. However, he argues that Hunter teaches a vacuum panel which contains at least one filler selected from inorganic powders and porous organic foams (col. 9, lines 21-29) and concludes that:

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to include a powder or foam as taught by Hunter in the panel taught by Benson et al. The motivation to do so would have been to increase the R-value significantly (Hunter, column 9, lines 46-49).

In my opinion, such a statement is absolutely groundless and contradictory to the teachings of both Benson and Hunter for the reason discussed below.

11. First, as already pointed out above, Benson specifically excludes the presence inside his vacuum envelope of fillers which may produce billions of microscopically fine glass fibers and perlite particles. This would also exclude the inorganic materials listed by Hunter and the inorganic powders of the presently claimed invention, since they tend to produce microscopic fibers or particles. I also wish to point out that porous organic foams likewise have the tendency to generate powders, and hence would be excluded by the teachings of Benson for at least that reason.

12. The Examiner’s alleged “motivation ... to increase the R-value significantly” is also erroneous and based on a faulty reasoning or misinterpretation of Hunter. The passage cited by the Examiner (col. 9, lines 46-49) states that “... the tensile and compressive elements 14 and 12 respectively may be alternated to increase the R-value of the barrier significantly.” However, elements 14 and 12 are not made of inorganic powder or porous organic foam, but are variously

corrugated sheets having a sine-like wave design (*e.g.*, Fig. 1) or more complex beam-like and cone-like designs (*e.g.*, Fig. 7). The stacking of these elements, as defined at col. 4, lines 47-51, is such that contact surfaces between two elements are reduced to a minimum to minimize the thermal conductivity in the solid phase, and are preferably reduced to “points of contact” between the elements (col. 6, lines 5-32 and particularly lines 21-25).

13. While it is true that Hunter shows elements 18, 19 (Figs. 10 and 11), which may be in the form of shaped polymeric foams or compacted powders, it is essential, according to Hunter, that these elements 18, 19 be used together with elements of the type 12, 14 to obtain the result of a high R-value.

The Examiner’s Erroneous Assumptions Regarding R-value

14. In paragraph 6 at page 10 of the Office Action, the Examiner states that Hunter “recognized that stationary air inhibits heat transfer” (col. 6, lines 40-43), thus teaching that stationary air trapped in the gas pockets of powder or foam would increase the R-value and provide motivation for the combination. This statement and conclusion of the Examiner are contrary to the teachings of Hunter and the knowledge of a person of at least ordinary skill in the art at the time of the invention and up to the present time. Thus, the entire paragraph at col. 6, lines 33-67 of Hunter is based on the premise that the panel be evacuated (col. 6, lines 35-37). The gases referred to therein are the traces of residual gases remaining after the evacuation of a closed space (if no residual gases were present, there would be no need of getter systems).

15. Benson already obtains a panel having a good vacuum level of at least 10^{-6} Torr or less (col. 11, lines 46-48), and vacuum achieves the best thermal insulation. Benson also provides for the use of a getter material (col. 4, lines 51-52). Therefore, the introduction of a filler according to Hunter in a panel of Benson would not involve any improvement in the contribution of convection (*i.e.*, gas motion) to thermal conductivity, because there are no gases in movement in Benson’s panel. To the contrary, the conductive contribution would increase in Benson by adding a filler according to Hunter, due to the thermal conduction of the solid filler material. Accordingly, the conclusion reached by the Examiner is simply incorrect, because combining the teachings of Hunter and Benson would decrease the R-value, instead of increasing

it. For the Examiner's information, the panels prepared at SAES according to this invention typically contain as filler either polyurethane or silica powder. With polyurethane, an R-value of 24 is typically obtained at a vacuum inside the panel of 0.1 mbar, while with silica typical values are $R \approx 32$ at a vacuum degree of 10 mbar.

16. In sum, the combination of Benson with Hunter would not have been suggested or even thinkable to one of ordinary skill in the art at the time of the invention because:

(a) Benson clearly states that his panels are incompatible with a filler in particulate form (fibers, powders, etc.);

(b) Hunter teaches that an increase in R-value is due to the presence of tensile and compressive elements 14 and 12, not to the use of a powder or foam filler;

(c) Hunter teaches that the elements 14 and 12 must be "as thin as possible and the contact surfaces reduced to a few points only";

(d) It is contrary to the teachings of both Benson and Hunter to use a filling material, such as the powders and foams of the presently claimed invention, that fills the space between the barrier sheets; and

(e) Filling a panel of Benson with a filling material would lead to a worsening of the thermal conductivity (increased by the contribution of the foam or powder) and would be meaningless.

Bending of Metal Sheets

17. In the paragraph at the bottom of page 3 of the Office Action, the Examiner notes that Benson discloses that his metal sheets "may be bent" (col. 6, lines 48-54), but acknowledges that Benson does not disclose the method by which the panel is curved. In fact, Benson further discloses that with proper spacing of the spacer beads 16, the insulation panel can be bent or formed around a curve without crimping or allowing a cold short between the two wall sheets (col. 7, lines 2-8). However, no difficulties are reported by Benson for the bending operation, so that it cannot be understood why a person skilled in the art would have made use of the

calendering operation of Späth for bending the sheets, particularly in view of the likelihood of breaking the glass or ceramic spacer beads, when subjecting the panel to calendering.

18. In the first paragraph of page 4 of the Office Action, the Examiner acknowledges that Benson does not disclose a vacuum panel comprising at least one metal (barrier) sheet having a thickness not greater than 100 μm . Instead, he relies upon Applicant's admission in the Background of the present application that envelopes made of barrier sheets having a thickness not greater than 100 μm are known in the art (paragraph [0005]). The Examiner concludes:

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to assemble and curve a vacuum panel as taught by Benson et al. in view of Späth et al. having a barrier sheet of less than 100 μm thickness. The motivation to do so would have been to create a high-performance insulation material occupying less volume that is therefore more valuable (Benson et al., column 12, lines 12-14).

19. Based on this reasoning, one could ask why Benson, although recognizing the advantages resulting from space-saving and a lower weight of the panel, teaches the use of metal sheets having a minimum thickness of 0.2 mm (col. 11, lines 53-54), i.e., 200 μm or twice the maximum thickness of the barrier sheet of the presently claimed invention. One reason could be Benson's statement at col. 6, lines 48-57, particularly lines 52-54, that the sheets must be "sufficiently hard or rigid so that they do not form around the spherical spacers, yet are bendable enough so that the panel can be formed in curves."

20. In actuality, sheets of a lower thickness, if used in a panel of Benson under a pressure difference of about 1 atmosphere (i.e., about 1 kg/cm^2) between the outside and inside of the panel, could show structural problems due to excessive stress, such as to break the sheets at points of contact with the internal spacers. Such pressure stress is not a problem with the presently claimed invention, since the filling material fully supports and spaces the sheets of the panel after creation of the vacuum.

Alleged Bendability of Hunter Panels

21. In the first full paragraph at page 3 of the Office Action, the Examiner takes the position that:

Hunter teaches a bendable vacuum panel (column 8, lines 57-67), which contains at least one filler selected from the group consisting of inorganic powders and porous organic foams (column 9, lines 21-29).

In fact, Hunter discloses at least two embodiments, and the Examiner has improperly assumed that the bendability of the panels of the first embodiment (as shown, for example, in Figs. 8 and 9) can be attributed to the second embodiment (shown, for example, in Figs. 10 and 11 and described at col. 9, lines 16-49), and *vice-a-versa*. The only passage of Hunter mentioning the possibility of bending (col. 8, lines 62-66) relates to the first embodiment (Figs. 8 and 9), which uses tensile and compressive elements 12 and 14 only, without any thermal insulation elements 18 and 19. The thermal insulation elements 18 and 19 are solid, formable, open structured materials made of foam, compacted powders or the like, used only in the second embodiment of Figs. 10 and 11. Nowhere in Hunter is it stated that the panels of the second embodiment can be curved.

22. It is my understanding from reports from our attorneys that, during a recent telephone interview, the Examiners took the position that the Benson panels with the filler of Hunter are “probably still bendable,” because both the filler and the barrier sheets are flexible themselves. In my opinion, the Examiners’ assumption is unwarranted, and their conclusion is incorrect. Thus, contrary to the Examiners’ assumption of probable bendability, the materials cited by Hunter at col. 9, lines 24-28 are all rigid, and the xerogel and ceramic foams are also brittle.

23. If the fillers of Hunter were flexible as contended by the Examiners, in a structure like that of Fig. 10, the walls 20 and 30 would compress the elements 18, 19 against the element 14 under the action of external pressure. As a result, the peculiar feature of the Hunter panels of having vacuum spaces between stacked elements would be lost. In other words, it is necessary that the “teeth” of elements 18, 19 be able to resist the pressure exerted by the panel walls, so

that the material of which they are made must necessarily be rigid. The Examiners' assumption of flexibility of the Hunter fillers is groundless, and the entire Hunter disclosure shows clear evidence to the contrary.

The Inapplicability of Späth

24. It is already acknowledged at paragraph [0013] of the present specification that the operation of calendaring is well known and applied in the mechanical field for curving metallic plates. However, we found that this operation can be successfully applied to vacuum panels, a possibility which was not foreseeable because of the discontinuity of the filling materials of vacuum panels and the unpredictability of their deformation behavior under mechanical stress. The breaking of foam boards was also expectable, given the general fragility of polymeric foams.

25. The Späth patent adds nothing to such prior art acknowledged in the present application. In fact, Späth does not even disclose the calendaring of panels, but only the folding or bending of metal profiles and sections, particularly hollow profiles.

26. Further, the hollow profiles or sections of Späth are self-supporting metallic parts. Although no indication is given of the thickness of such metallic parts, metallic tubes are mentioned and shown in the drawing, which must have a thickness of at least some millimeters. In contrast, the barrier sheet of the panels of the presently claimed invention, which may include a metal layer (claim 13), have a negligible thickness, being only a fraction of the multi-layer barrier thickness (100 μm at maximum). Accordingly, the supporting portion for the panel envelopes of the presently claimed invention is the filler, not the extremely thin metal layer.

Conclusion

27. In sum, the presently claimed invention is directed to a method for curving thin-walled vacuum panels supported by a porous or discontinuous filling material of inorganic powders and/or porous organic foams by a calendaring operation. The Examiner has failed to cite any prior art document in the technical field of vacuum insulating panels that discloses

calendaring thereof. For all of the above reasons, the Examiner's conclusions of obviousness are unsupported and based on erroneous assumptions and reasoning.

I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that those statements were made with the knowledge that willful false statements the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

3/8/2006
Date

Paolo Manini
Paolo Manini